Topographic Waves on Slopes

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LONG-TERM GOALS

I seek to understand the influence of midlatitude jets on the surrounding ocean. The interrelations between meandering, radiation of low frequency energy and resulting mean flow generation have been of particular interest and relevance to my recent work.

OBJECTIVES

The guiding hypothesis is that the meandering of western boundary currents acts as a wavemaker in the ocean. The meanders are quite depth independent and force mainly barotropic motions exterior to them. These motions propagate as low frequency Rossby waves and those to the north of the stream eventually become topographic Rossby waves as they begin to feel the bottom topography. I am studying the effects of nonlinearities and steep topography on these waves as they shoal and refract.

APPROACH

The results from an array of current meters, deployed in late summer of 1995 on the Continental Rise to the west of the Grand Banks, are the inspiration for this study (Hogg, 2000). Although an interpretation of the low frequency variability in terms of topographic Rossby waves was compelling, it was clear that a number of the implicit assumptions were violated: namely small amplitude waves and gentle slopes. To this end I am performing numerical experiments using the Rutgers "ROMS" numerical model. I have completed barotropic experiments and have begun to make baroclinic runs.

WORK COMPLETED

Numerical modeling of shoaling Rossby waves has been one activity for the present contract year. The other has been to collaborate on a manuscript which describes results from mooring work in the Ulleung Basin of the Japan/East Sea. This has been accepted for publication in *Deep-Sea Research I* (Chang et al., in press).

RESULTS

For the Rossby wave radiation problem the modeling domain is periodic in the east-west direction and the topography shoals to the north. Waves are forced near the southern boundary by a windstress at

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14. ABSTRACT

I seek to understand the influence of midlatitude jets on the surrounding ocean. The interrelations between meandering, radiation of low frequency energy and resulting mean flow generation have been of particular interest and relevance to my recent work.

15. SUBJECT TERMS

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the surface which is periodic in the east-west direction and in time and has north-south scales determined from the linear dispersion relation so as to tune the response for northward propagating energy. I have completed barotropic runs for both small amplitude and large amplitude forcing and include the results for the latter case in the accompanying figure.

The upper left panel shows the kinetic energy as a function of north-south distance in the northern third of the domain. The upper right panel gives the bottom depth (blue line) and wave-forced cumulative transport, both predicted (red line) and actual (green line). Although the prediction works well in the small amplitude case (not shown) it clearly does not for this nonlinear situation. Another indication of the strength of the nonlinear interactions is the frequency – cross-slope wavenumber spectrum (bottom panel). The forcing is at the points indicated by the heavy solid dots but the response spreads in a ridge along the linear dispersion curve (solid bell-shaped curve). This work is now being extended to the baroclinic situation.
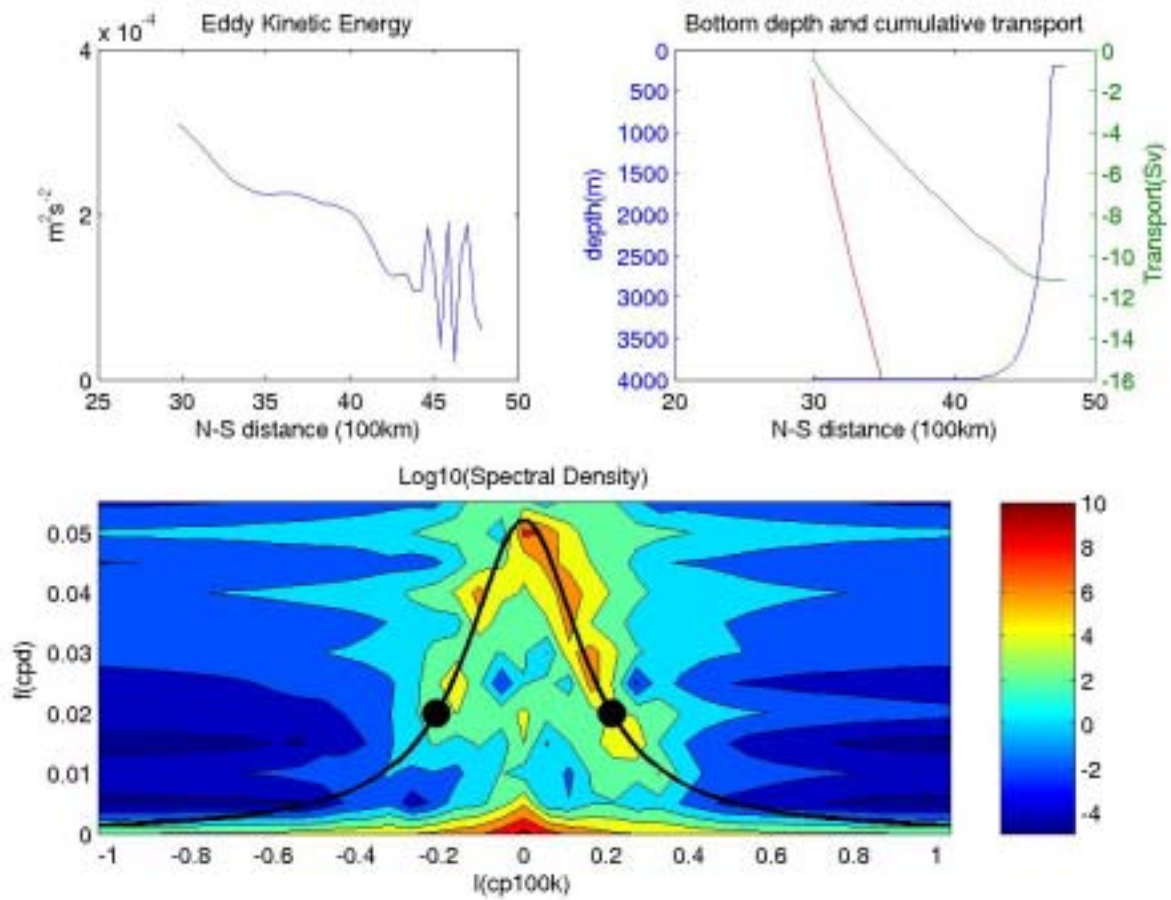
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PUBLICATIONS

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